

ON THE PATANI.

THE Patani river takes its rise in the same mountains from which fall the northern tributaries of the Pêrak, about 5.35 north latitude.

The Pêrak, fed by the watershed from the western slopes on the ranges which divide Kêlantan and the Patani provinces from Pêrak and Kêdah, flows southerly; whilst the Patani, draining the eastern flank of a small section of the northern extremity of these ranges, takes a northerly course and falls into the Gulf of Siam in latitude 6.55 north.

Patani was formerly a rather extensive country, but after being subdued by the Siamese, it was subdivided into minor provinces, probably with the view of weakening its power of resistance by destroying its solidarity; and the whole of these minor provinces, along with a number of others in Siamese Malaya, were put under the jurisdiction of Singora, or Songkra, which is the largest and most important of the Siamese Malayan States.

The provinces through which the Patani river flows (beginning at its source) are Raman, Jalor, Nunchit, or Nuchi, and Patani, the last embracing country on both sides of the river at the Kuâla; the largest of these provinces is Raman, and the smallest Patani, and each has a Râja of its own who is directly responsible to the Chow Kun of Singora.

The bay of Patani is formed by the projection of a narrow strip of land about seven or eight miles in length which, connected with the mainland to the eastward, bends round to the north-west in the form of a horn or segment of a circle and protects the roadstead; so that vessels can at most seasons ride in safety; the western extremity of this projection is called Cape Patani.

The Patani has an extensive delta which has not yet been thoroughly explored, and which is intersected by numerous creeks.

The principal of these are Kuâla Barat, Kuâla Plimau, Kuâla Tujông, or Ayer Tawar, Kuâla Lisah, Kuâla Kayu and Kuâla Tunyo, besides many smaller ones of which I could not ascertain the names. The most important is Kuâla Tujong, or Ayer Tawar, which bifurcates from the Patani about ten miles up that river and is there called Kuâla Nuchi; it has thus three names—Tujong, Ayer Tawar, and Nuchi; all the others are branches from it and I have little doubt but that at one time the Tujong was the main river, indeed if judged by size and volume of water it may still be considered so. At the sea it is much deeper than the Patani, and tongkangs of considerable burthen can go up as far as its junction with the Patani at Kuâla Nochi.

There are many instances on the east coast of the Malay Peninsula of rivers having changed their course in a very remarkable manner; here a little below Kuâla Nuchi, on the Patani, stretches a belt of rock across the bed of the river which originally no doubt caused it to take the course of the Tujong until the accumulation of silt and *detritus* raised the level of its bed and then the floods burst over this belt and forced a channel in the direction of what is now Patani.

Further down the river from Kuâla Nuchi is another small creek called Kuâla Lëmbu, which cuts across the angle formed by the Tujong and Patani, and thus further connects these two streams. The rough sketch map attached shews, to a certain extent, the ramifications of this delta.

In reference to the term Kuâla it may be well to mention that, as in the case of the Tujong, it is applied indifferently either to the opening where a stream debouches on the sea or falls into another river, or to that whence it breaks off from another river; this is common in Malaya, and a knowledge of the fact is necessary to prevent confusion when perusing any description of these rivers.

The town of Patani is situated about two miles up from the Kuâla and is of considerable importance; a very fair amount of trade being carried on with Singapore and Bangkok, as also with the neighbouring Siamese and Malayan States. It exports tin, lead, gutta, salt fish, tiles and earthenware, and occasionally tim-

ber. The population of the town, consisting of Malays, Chinese and Siamese, I should estimate roughly at from three to four thousand, but up to the time of my departure (September, 1881) no proper census had been taken, and none of the authorities could give any precise information on the subject. The Malay race preponderates. The town has a Chinese and a Malay quarter; the Chinese quarter consists mainly of one tolerably good street running at a right angle with the river; a large covered gateway substantially built of brick or stone and plaster opens from the river bank into this street and many of the houses which are used as shops and residences combined are of the same material and well constructed.

The Malay quarter lies a few rods further up and is more or less straggling, although the frontage to the river is lined with houses at moderate intervals and an almost continuous fence stretches as far as the Râja's landing place about a mile further up.

The Râja's palace or residence is a rather handsome one-storied building situated about a furlong from the river, it is built of brick plastered, and the roof, which is tiled, is decorated in the Siamese fashion, which much resembles that of the Chinese, if indeed it is not altogether borrowed therefrom; it has an extensive court and very wide double verandahs at front and sides, the floor of the inner one being raised a step above that of the outer; both floors are handsomely laid with large squares of polished tiles, and the roof is supported by numerous massive pillars, which give to the whole a rather imposing effect. Here the Râja holds court, receives visitors, and deals out judgment; the dwelling rooms are partitioned off by tall wooden screens extending from floor to roof corresponding with the form of the building (quadrilateral) and elaborately carved, coloured and gilt. The Râja is a young man of very gentle manners, and advanced ideas, and administers the affairs of his province with much ability.

The active commercial and shipping business is controlled by a Captain China, who combines in his person many offices; he is shipping master, collector of customs, collector of inland duties, and Magistrate absolute in cases of disputes among the Chinese.

There is another important officer in Patani, the Datoh of the mines, CHEW BENG by name; he is also the opium farmer. He is a

man of great force of character, and exercises more power throughout the Patani provinces than any other individual in them: he is elder brother to the Captain China, and both, as well as the Râja, are under the immediate control of Singora.

The people are quiet and comparatively industrious, but a not inconsiderable portion of the town labour is left to the women, who may be seen plodding about a great part of the day with loads of various descriptions balanced on their heads.

There is a goodly company of Siamese priests in Patani, and it is one of the sights of the place to watch them of a morning in companies of twenty or more arrayed in their robes of yellow calico marching in Indian file through the town to receive their daily alms, visiting from door to door with great solemnity, and headed by a kind of high priest before whom is borne a long gold or silver headed staff or rod. Their robes are worn much as the Kling Chitties wear their white and airy costume, but are much more voluminous, and under the ample folds of these they carry large baskets in which are deposited the voluntary contributions of the people. Few, if any, words are exchanged as the yellow regiment proceeds on its house-to-house visitation, which is conducted in the most perfect order, and, generally speaking, the inhabitants are all in waiting outside their doors with their offerings of rice, fish, cakes and other food. This is part of their religious system and seems to be cheerfully acquiesced in even by those who are not of the Siamese persuasion. Celibacy is a strict law of the priesthood, and I was informed that for one of their order even so much as to touch one of the other sex is a high offence.

Many youths even of good families, such as sons of the Râjas in the Siamese provinces, enter the priesthood for a period (a kind of noviciate) in order to be inducted into the mysteries of their religion, as also to receive a good education, and, as a rule, the education of the Siamese youth is, to a large extent, entrusted to the priests.

The Siamese dialect is very much used in Patani and is spoken fluently by most of the Chinese and also by many of the Malays; it is the official language of the country and must be used in all communications with Singora, where it is exceedingly difficult to

find anyone who can talk Malay.

The traffic on the Patani is principally carried on by means of long flat *prahus*, chiefly made in Kēlantan; they are decked right over the gunwale, and, fore and aft, two broad stages extend beyond the stern and bow respectively, whilst the centre is covered by a low deck-house about five feet in height at the ridge. This deck house is often about 20 feet long and is divided into two compartments, one for the men and the other for the master or *nakhoda*, the latter facing the forepart of the *prahu*; the entire length of these boats from the extreme end of one stage to that of the other is sometimes about sixty feet, and the width about seven; the fore stage is used as a platform for the boatmen or polers, and that at the stern for the steersman and also for cooking operations.

To a novice, the poling is a very interesting as well as a peculiar performance, and it is conducted on this river in a very energetic and systematic manner; there are generally four men employed, but, if speed is wanted, two extra are put on. The poles are from twelve to fourteen feet in length, and for deeper portions of the river even longer ones are used, the point is sheathed with a strong sharp iron ferule, which enables it more easily to dig into the gravelly beds of the river and also protects the wood from wearing. At the head of the pole a small block of wood is fixed in which is hollowed a slight curve so as to fit the breast of the poler; when the start is made, the first two men proceed to the bow end of the stage and digging their poles into the bed of the river, one on either side, place the block against the hollow of the chest just above the armpit, right or left according to the side on which the man is working; each then pushes with might and main, walking aft as the *prahu* is propelled along until he reaches the deck-house, then each lifts his pole out of the water. Meantime the other two couples have followed suit and are close upon the heels of those in front of them, each of whom deftly poises his pole so that the lower half passes over the heads of his followers whilst the upper portion crosses that of his opposite neighbour without clashing and in this manner the two walk sharply back to the bow and again take hold of ground, pushing as before; six men, three on each side of the comparatively narrow stage, going

through this performance without a stoppage or a hitch, present rather a graceful spectacle; the action is rythmical and calls to mind one of the figures in Sir Roger de Coverley. Where the current is strong, there is a great strain upon the men, and every muscle shews out in bold relief, their eyes seem starting out of their sockets, their bodies are bent forward until almost horizontal, and with toes and hands they grip and clutch at every projection they can lay hold of to help to push and pull themselves along, often uttering all the while wild and unearthly cries, which are rather startling to the nerves when heard for the first time; it is tremendous labour, yet they will keep it up for hours, only stopping occasionally to refresh themselves with a quid of *sirih*; this pressure upon the chest, however, frequently brings on pulmonary complaints, yet the men who have once fairly gone in for this life will not settle down to any other kind of work.

During all the time this poling is going on, the passenger is "cabined, cribbed and confined" in the low deck-house; for he can't go out forward, or he would interfere with the polers, nor aft, lest he disturb the "man at the wheel" or the genius of the *dapor* (*i.e.*, *cook*). However, at meal times, when the *prahu* stops, he has some respite, and at the close of day, when mooring for the night, comes compensation; a clean gravelly beach has been selected for the camping ground, the sun has sunk behind the jungle parapets, but the glorious tints with which he paints the sky as he retires to rest are mirrored and multiplied in the peaceful river and framed in the tracery of the primeval forest, presenting a picture of ethereal beauty ever changing under some fresh combination of coloured light, until purple shades and sombre hues begin to eclipse the ruddy tints and finally the view dissolves and Queen Night asserts her kingdom. Now the camp fires are alight, the *damars** are flaring, swarthy groups are gathered round the friendly blaze discussing the evening meal, the piercing ring of the cicala has made way for the voices of the frogs, and the night birds and the appropriate music of darkness has begun; bye and bye the moon begins to rise, and the traveller, having refreshed his inner man and lighted up the fragrant weed, contemplates the scene with a keen sense of enjoyment.

* Torches.

These *prahus* are admirably suited for river traffic, and in some instances carry about a hundred pikuls.

From Patani to Kuâla Nuchi the river's course lies for some distance between extensive padi-fields, the banks clothed to a considerable depth with the feathery bamboo, the graceful cocoa-nut palm and other fruit trees; at short intervals the brown *ataps** of the native huts peep out from amidst the redundant foliage, tawny beauties gracefully draped in many-coloured robes gaze dreamily at us as we pass along, and, combined with the happy voices of children add life and music to the scene.

Further up the Patani lies Biserah, the principal river *kampong* of the Jalor province, distant from the town of Patani in a straight line about 25 miles, but double that, or even more, by river.

Within a couple of miles of Biserah is situated a remarkable idol cave to which I referred in my paper on Kota Glanggi published in this Journal (No. IX, June 1882).

It did not occur to me at the time of writing that description to state that the idols therein referred to are not carved out of the rock as in the caves of Elephanta and others of note, but are built of brick and stone and then plastered over. On coming to read the article in print, however, when I returned to Singapore, it struck me that it was an omission which might lead to erroneous impressions, and therefore I take this opportunity of explaining: the length of the cave, also, should have been printed 300 feet not 500.

The hill in which this cave exists is the first of a series of isolated cliffs which here begin to dot the plain and which are but the outposts of a regular and connected series of limestone ranges, precipitous, rugged and grand, which lie a little further to the south.

To the north-west, a bold mountain range with lofty peak rises abruptly out of the level country, and is, I should say, not less than 4,000 feet high, probably more, but I have not ascended it yet. It is known generally as Bukit Bësar; its base stretches over a wide extent of country, and from all the plains around, for a distance of twenty miles or more, and from some distance out at

* Palm-thatch.

sea, it is a conspicuous and imposing feature in the view. About four miles from the idol cave lies Kampong Râja, or Jalor; here the Râja resides in a plain *atap* building. He is surrounded by a goodly number of native huts, and there is a considerable population. There are extensive padi-fields which are worked on a very good system of irrigation. The Râja of Jalor, to whom I am indebted for much kindness, is an oldish man; he possesses a goodly number of elephants from which he derives a considerable revenue; his country lies chiefly on the west bank of the river, although he also holds on both banks. About the same distance on the opposite side in a south-easterly direction, lies Kota Bharu in Raman, the seat of the Râja of that province. Râja RAMAN is a man of liberal ideas and exceedingly anxious to cultivate a knowledge of European manners and customs; he is a fair artisan and a Nimrod in the jungle.

At his court, which, like that of Jalor, consists of a series of *atap* houses, are workmen skilled in the manufacture of spears, kris, *parangs* and other weapons; there are also good carvers in wood and workers in gold. The Râja himself makes very handsome *howdahs* of fine wrought *rotan* for his elephants, of which he has the largest number of any Râja in the provinces, as he is continually capturing and breaking in fresh ones. He made me a present of a very handsome *howdah* wrought by his own hands; he is affable and courteous, and any European visiting Kota Bharu may rely upon a hospitable reception.

Leaving this portion of the river, we now commence to penetrate into the wild mountain country of the interior, and as the river wends its tortuous way in and out amongst mountain ranges, many vistas of surpassing beauty open out to delight the eye; the river becomes more rapid, and beneath its rippling current may be seen clear gravel beds and sandy bottoms over which dart myriads of the finny tribe; occasionally bold rocky masses start out from beneath a mountain of foliage, and sheltered by these lie deep and silent pools, curtained with overhanging tapestry, wrought in all the wealth of colour and design which the luxuriance of tropical foliage so lavishly supplies. In many of these pools excellent fish are to be obtained, and, although I ought perhaps to blush for the un-

sportsmanlike procedure, it was customary with us, when ascending and descending the river, to summon all the natives within hail—men, women and children—and with the aid of a dynamite cartridge raise more fish of all kinds and sizes in five minutes than the whole tribes around us had seen for months: the rush into the water pell-mell, helter-skelter, of the whole crowd, and the shouts of glee and laughter, were something to see and hear, the women and children were particularly amusing, whilst the capture of the fish delighted them, fed them, and afforded us infinite pleasure to witness the unbounded delight which it occasioned.

Bukit Bĕsar beyond Jalor, already referred to, is of granite formation with upheaved schist and limestone and on the other bank above Biserah lie Bukits Bilau and Ko Pinang, both of granite formation largely intermixed with quartz; these are lofty mountains similar to Bukit Bĕsar, rugged and picturesque. On this part of the river are many high gravel beaches consisting almost entirely of rounded white quartz, sparsely intermixed with granite, schist, and limestone shales. Here the eye may travel from undulating range to range, rolling wave-like between these monarchs of the mountains, all taking one direction nearly due south. The strike of the schistose and limestone strata is, with slight variation, east and west, and the idea suggests itself of a vast plutonic ocean hurling its irresistible billows southward, breaking up into one regular system of fracture, the superincumbent strata, which, yielding to the impulse of the moving mass, have formed into the smaller waves of a shallower sea. I do not as yet venture to propound this as a geological thesis, I only mean to say that the idea suggests itself.

Passing through many scenes of this description, we reach Banisita, which is situated about forty-five to fifty miles nearly due south of Patani, although the river mileage is very much greater; Banisita is the depôt for the galena mines in this neighbourhood and is situated in a very picturesque amphitheatre through which flows the Patani river. In the centre of this amphitheatre there is an open level plain in which are many padi-fields, with a hill of forest encircling it; beyond this hill rise undulating wooded ridges; behind these again, at intervals tower vast walls of

limestone cliffs; and still further in the back ground soar the lofty summits of the Raman mountains.

The floor of this amphitheatre, so to speak, is, as I have said, perfectly level; on one side of the open plain flows the river, the banks of which are here from fifteen to twenty feet high and quite perpendicular, so that an excellent section of the soil is obtained; it consists of decomposed limestone mixed with sand, forming a substance like pipe-clay with gritty particles of quartz and felspar, and makes, I was told, excellent pottery when properly prepared; it seems to have been deposited under still-water and has all the appearance of a lake or deep sea bed; probably in the course of its history it has been both. There are no large boulders in it, and, except close to the river bed, no gravel. Near the godown of the company this deposit rests on limestone, which crops up in the bed of the river.

The galena mines are situated between eight and nine miles to the west of Banisita. The journey is performed on elephants, of which there are trains constantly passing to and fro, nearly all the traffic being conducted by means of these invaluable animals. Buffaloes are likewise employed, but as each beast can only carry about 133 katis, whilst an elephant will take from three and a half to five pikuls, according to size and strength, the latter animal is much more profitable. About four miles out from Banisita, on the way to the mines, the traveller enters into the heart of the limestone country, long lines of perpendicular cliffs, all crowned with foliage, rear their serrate summits to the sky; some are over a thousand feet high, and throw out here and there from their rugged walls bold abutments from which depend huge stalactites that seem almost to hang in air; from the brows of others project spiked masses and needle-like columns crowded together in fantastic groups, like some vast *chevaux de frise*, and down their rugged walls, the prevailing white of which is occasionally varied by streaks of purple, blue and ochre, hang luxuriant tassels of creeper, fern and flower; high up on the precipices may be seen the denticulated jaws of many a cavern gaping at space, whose mysterious recesses no man may penetrate, for they are out of the reach of even the most enterprising goat.

Caves there are also on a level with the ground, through many of which one may travel for considerable distances.

As one approaches the galena mines, the road winds in and out among cliffs with clear rushing streams meandering at their base; and every here and there a glimpse is obtained of some narrow valley with its precipitous walls and hanging verdure.

One very striking peculiarity in the formation of the country here is the alternate succession of ridges or waves of limestone and granite; these limestone cliffs will be found cut down clear to the granite, the junction plainly visible; at the very base of the cliff a stream will be found running over a granite bed, and, gradually rising from this stream on the opposite bank, the slope of a granite range; on the other side of this range, again, will be found another series of limestone cliffs, and so on for many miles.

The cliffs almost invariably face the south, and the strike, or longitudinal line runs about east and west, or a little to the north of west and a little to the south of east, which would shew a south and by westerly direction of the general flow of country. The back or north sides of these cliffs present almost always a gradual rise; this rise consists generally of chaotic heaps of vast blocks of broken and disjointed rock. I use the term "vast" advisedly, for these blocks or mountain masses of limestone convey most distinctly to the mind the idea of a mountain-side having been simply churned into fragments by some violent plutonic action. It is an exceedingly difficult and tiresome feat climbing over these, as everywhere ugly crevasses present themselves, into which a false step may plunge the unwary; these rocks have edges as sharp as knives, and a false step or a careless movement may cost the climber's shins a considerable strip of epidermis. At the base or north again of this rise will be found granite ranges, steep to the south, but sloping to the north. Now, if we consider these granite ranges, for the sake of illustration, to be the waves of some vast plutonic sea which, rolling its course along, has lifted and broken up the limestone strata and pushed its way southwards (the crests of its waves standing high above the country which originally covered them, and, as we see in the waves of the ocean, the back-water sloping gradually in the direction from whence it came), we

can conceive the limestone, following a similar impulse, would present a crested or vertical front, whilst the back flow would be represented by the chaotic debris above referred to, lying at a comparatively low angle. Now, at the galena mines this is not a solitary occurrence; it is frequent and systematic; wave of limestone succeeds wave of granite for many miles. Without, however, attempting to dogmatise, it may have been that an undulating earthquake really did travel the Peninsula from north to south, or it may be that a simple upheaval took place and rose, so that there should be a systematic and regular alternation of granite and limestone ridges, ridge upon ridge of granite rising just so that at the back of each ridge should lie a corresponding ridge of limestone.

But, whatever may have been the nature of the movement of the forces which disturbed this country, the phenomena related undoubtedly exist. These remarks are the result of long and careful observation.

In the valley of Goa Tumbus, there are several isolated limestone peaks and the one from which the valley takes its name—Goa Tumbus—is perforated from one side to the other by a large opening giving the idea of a gigantic gateway. This rock or hill is not less than two or three hundred feet high, and the opening is probably about one hundred feet high and about four hundred feet in length. The interior of this opening would make a magnificent hall; it is well lighted from both sides, and the openings are festooned with creepers and other vegetation; it is perfectly dry, and as one stands in the middle of it, the look-out from either side presenting a long vista of rich green forest, produces a very striking effect.

Among other eccentricities of the limestone formation, I have occasionally met with in some of the caves a very beautiful phenomenon—petrified cascades or waterfalls; such the eye would at first declare them; they are, however, merely the drippings of lime-impregnated water which, falling regularly from the ceiling, happen to have lighted on stones presenting many successive layers, and, falling or sliding from one to the other, the deposit of limestone has gradually formed into this shape, and the rounded and sprayey volumes of a cascade are imitated with a fidelity which is startling.

Imagine the time one of these cascades must have taken to accumulate, and yet, as compared with the rocks themselves, they are but things of yesterday. In one cave on Penyu there is a very fine specimen of this kind ; it is semicircular and about fifteen feet high, the fall is symmetrical and the resemblance to a cascade complete.

In Tilowaya Jalor, the river Gorah runs right through part of one of the loftiest limestone mountains in the country, it seems to take a corner of the mountain and flows through a long succession of caves. I followed it from one end to the other, here and there there were smaller passages, which again opened out into wide caverns alive with bats ; it has a peculiar weird sensation this wandering through long galleries of gloom with the rippling and splashing of water for ever sounding in the ear and echoed and re-echoed from the vaulted ceilings of the caverns in a never ceasing *swish ! swish ! swish !* which is both monotonous and eerie, whilst the air is permeated with the all pervading and though muffled yet powerful sound produced by the flutter of untold myriads of wings.

There is one striking and suggestive phenomenon in connection with all these limestone cliffs ; they all bear the indisputable marks of the action of water from the extreme summit to the base, there are innumerable round and deep holes smooth and symmetrical as if worn out by the eddying of the softer element, there are ripple marks and smooth hollow grooves and these are not at any great distances from each other, but are met with at every step, they are not peculiar to one range alone, but are found on all, and indicate a general submergence and a very slow and gradual rise, or *vice versa*. I am inclined to ascribe these phenomena to the action of the sea and not to that of stream or lake. There are frequent instances of large rocks more or less pyramidal in form, rounded at the angles and each face smooth and slightly concave just such an effect as the action of the tides would produce ; in the caves, and overhanging ledges the roofs are worn in long and wide smooth grooves as if from the constant lapping of the waves, and there are rounded protruding benches evidently proceeding from the same cause, these cannot be ascribed to foldings of the strata as is the case in some parts of North Devon. Here in Patani the limestone

is crystalline and entirely altered so that all signs of stratification are in most instances destroyed. Although there are some formations which are less altered, and where these occur we find the strata dipping at a low angle to the north and tilted up to the south as previously described. During my investigations I was unable to obtain any evidence of organic remains. I found no fossils, and I concluded that in the process of metamorphism they had all been destroyed. It is but fair to say, however, that I have since been told by Mr. C. M. ALLEN, who was engaged at the galena mines some years ago, that he had obtained small fossil shells in the limestone, but, so far as my experience goes, neither with the naked eye nor with the aid of the microscope was I successful in discovering any evidence whatever of their existence, although I searched long and laboriously.

It may be conjectured from the continuous signs of water-wearing, not occurring at spasmodic intervals but in a gradual scale of ascent or descent, and also from the very distinct nature and extent of the watermarks, that this country must have occupied long ages in its emergence from above the ocean level, otherwise the water would not have had time to leave such decided traces of its action from summit to base. Of the nature of these limestone cliffs, I may say that there are white crystalline marbles not unlike loaf-sugar, there are blue compact limestones, occasionally in the lower ground dark compact stratified and highly indurated shales, but the mass of these cliffs, where exposed, is of a white crystalline character, much interspersed with lodes or fissure veins of felspar and quartz.

The feldspathic crystals often occurring in large cubes, three and four inches square. The limestone when in flat bevelled slabs often gives forth a clear bell-like ring when struck by the hammer and when in large masses of this form it produces a deep rich tone like a powerful gong.

In the limestone ranges there are many veins of galena more or less productive and generally associated with quartz or felspar. Whether they are fissure veins belonging merely to the limestone formation, or parts of a distinct system which has its origin in the underlying granite, is a question that may be considered still open,

but during long and careful observations, extending over a period of fourteen months, I did not find any traces of galena veins in granite itself. I found, however, that there existed a distinct mineral band or belt, about two miles in width striking south and by west, and within this belt, these veins of galena were frequent, whilst the largest and most productive lodes, although each series was broken and disconnected by the intervening granite, were found running in one straight and clearly defined line in the same direction, although not necessarily having all the same direction of strike, the contortions of the limestone causing the same lode to assume different bearings according to the displacement of the rock.

If the reader will glance at the rough sketch map, he will note to the north in the Goa Tumbus Valley the words "Great Lode;" this is a wide strong lode of lead with copper and iron pyrites, and extends downwards into the shales which exist at this place; from thence draw a line to "No. 3" which is in the limestone on the other side of the intervening granite, this is also a strong lode of the finest galena, not yet traced to shale, but cased in crystalline limestone; from thence again in the same direction draw a line to the place marked "Kim Ching Valley" and here again occur numerous veins of galena whilst a hill of granite intervenes between this limestone and that of No. 3. Galena is also found on the opposite valley in the same direction, granite again intervening.

Further to the north-west in the valley of Goa Tumbus draw a line from the point where a large lode is marked as cropping up in the stream, this is also more or less in shales and highly impregnated with pyrites; now draw a line from this in the same direction as the previous one and it will be found to cut the point marked "No. 1 Mine," which was the largest lode of galena that has ever been discovered in Malaya and of first quality; continue the line again and it strikes at the head of the Kim Ching Valley where a series of rich lodes exist to the present day. I may remark that these lodes occurring in the crystalline limestones contain silver in proportions varying from 23 to 66 oz. to the ton.

The tin deposits which in this part of the country are mostly worked on the hills, will also be found more or less to follow the

same line of strike, as for example from the hill in Goa Tumbus Valley marked "Chew Beng's Mine" a line in the same direction cuts "Epoh Mine" on the next granite exposure, and again on the line marked "Tan Lim," whilst again, further to the north-west, the same continuity exists; thus a clearly defined mineral band striking from the east of north to the west of south would appear to be established, and, as I have before remarked, it is a question whether this apparent continuity arises from impregnation from the plutonic rocks or is the result of crystallisation in a particular line of magnetic current or other procuring cause.

In other words, did the infusion, infiltration, crystallisation or whatever the process which superinduced the formation of the galena (sulphide of lead) occur when the limestone was one level mass or after or at the time of its disturbance, or, on the other hand, are the existence of all the minerals here to be attributed to impregnation or metamorphism produced by the plutonic rocks? As I have before stated, I have found no galena veins in the granite ranges themselves. I have found the galena when embedded in the lower shales highly impregnated with pyrites and minus silver and I have found the purest galena and the best yield of silver near the summits of the limestone formation.

I have often heard it stated in Singapore that the galena of these mines exists in pockets in the alluvial or earthy soil which was apparently assumed to be its natural habit; the actual fact, however, is that whilst it is found frequently in what we call pockets imbedded in clay and earthy soil, yet in this phase it is not *in situ*. When so found it is in the form of more or less rounded boulders of pure galena encrusted with a thin coating of limestone or of carbonate of lead, these boulders I have seen as heavy as six and seven pikuls each; and as much as seven or eight hundred pikuls was obtained in more than one instance whilst I was there from pockets of this description. Now I have never known any of these so-called pockets in the immediate vicinity of which, that is, within a yard or two or even immediately beneath or above them, there has not been found to exist a lode *in situ*, and the simple explanation of the existence of these boulders of galena is that they are merely the result of the breaking away from the overhanging

rocks of some of these veins of galena which becoming gradually severed from the mother rock by the insidious action of the water in the still depths of the ocean, have slid down to the nearest projection and there have been until the day of discovery, their great weight and size having defied the efforts of flood or stream to disintegrate or carry them away. They may, however, have been detached from the matrix by other forces of nature, such as the undermining of waves or streams or by atmospheric action, but the principle of their existence is the same, however detached from the parent rock, whilst the coating of lime gradually formed around them has, to a large extent, prevented their disintegration. After exhausting these accumulated heaps of galena, the lode itself has been found to continue its downward dip and has been followed to considerable depths with much profit to the miners; in these cases, the upper portion of the lode had broken off, whilst that below being embedded in the rock could not be affected.

There was one remarkable instance of this at Pinyuk on the galena mines of the Patani in which the lode was not exhausted after twelve months' work, but still held its downward course through the living rock in conjunction with galena.

Galena being of a very friable nature, is, if not in a compact mass, easily disintegrated, and consequently on all these hills and in the limestone valleys, *i. e.*, in valleys where the entire formation is limestone, there are large deposits of alluvial galena which can be extracted by washing the drifts.

There are to be found here considerable deposits of carbonate of lead and also of phosphate of lead, and some very beautiful specimens of the former are often met with. Copper in the form of pseudo-malachite is also of common occurrence.

Tin is also more or less abundant on the granite hills and slopes, and is worked by the Chinese with considerable vigor, almost always on the hills; it is also plentiful in the beds of the rivers which flow between the granite and the limestone cliffs, and it is a peculiar circumstance that very little alluvial galena is found in these same streams, a phenomenon which seems to indicate that the surface changes in the rocks have not been the result of river denudation and the watermarks on the limestone hills have not

been produced by such action, for had the valleys been scooped out by that process, galena would undoubtedly be found in the beds of these streams in even greater proportions than tin, for its superior specific gravity would enable it to hold its own against the currents and prevent its being carried away to any great distance, whilst the fact of its abundant existence *in situ* on the very verge of these rivers leaves no room for doubt that had there occurred such a process of denudation ample deposits of galena would have resulted.

These rivers are fed from the slopes of the granite ranges which at one time have been and may be even now, extensively reticulated with thin veins of cassiterite, or tin stone, which, during the erosion of ages has been freed from the parent rock and carried down by the watershed. The tin found in these streams is generally of a very pure quality, but very small in grain. The richest tin mines in Patani are held by Datoh CHEW BENG and are very profitable. As before stated. Tin is found in large deposits on the tops of hills bordering the great lines of granite ranges. These hills are composed of a reddish brown sandstone, soft and spongy near the surface, "Batu Mati" as the natives call it, *i. e.* "dead stone." The Chinese call it "Seeow." Both above and below this, good tin is obtained, but the lower strata often contain wolfrum, *i. e.*, tungstate of manganese and the sandstones which become harder the further the distance from the surface are highly impregnated with iron and manganese, hence many Chinese *kongsis*, who have for years been working and smelting the surface tins with great success, are often very much perplexed by suddenly finding, upon reaching deeper ground, that their ore no longer yields bright tin but only a cindery looking slag.

The tin-bearing hills are worked by means of water races brought from the mountain streams high up the granite ranges and are frequently constructed at great cost and brought from considerable distances, along the sinuous contour of the mountain spurs. Having obtained a good and constant supply of water, the stream is turned on to the stanniferous ground, which is broken up by the miners by means of chocks. A chock is a kind of crowbar; it consists of a long, heavy, thick-pointed, spear-shaped iron head

with a socket, in which a strong shaft of wood is fixed, it is very heavy and the miners simply lift it vertically and then plunge it into the rock or earth releasing a considerable quantity at a time, and this, falling into the stream which is made to deviate so as to follow the miners, becomes disintegrated and is washed down the hill, to a lower platform where a good deal of the tin remains whilst the debris continues its course down the hill and passes through sluice boxes where any remaining mineral is retained. The existence of these deposits of tin often very rich on the summit of hills which are in many instances isolated rising up all round above the ground immediately surrounding them, is a phenomenon somewhat perplexing, and must at once attract the attention of the observer, but what is still more perplexing is that these deposits of tin will be found mixed or coexistent with deposits of carbonate of lead as in Datoh CHEW BENG's mine at Goa Tumbus marked on the sketch map. On this hill there are distinct deposits of tin of fine quality alternating with deposits of carbonate of lead. Space will not admit of my going fully in this paper into the mineral phenomena of the country, but I may state that the general result of my observations through Patani was that the chief, if not the only, factor in the distribution of the alluvial minerals has been the ocean, and that river denudation has not in its most recent phase affected the present contour of the country or the deposit of mineral except where existing in the rivers to any appreciable extent.

It may be that the deposits of tin are entirely prehistoric to the formation of the limestones and, therefore, to the subsequent changes of the surface, and it is possible that a stanniferous hill like Datoh CHEW BENG's may, when beneath the sea, have been subject to the action of under-currents and swirls which have eroded the surface without carrying away the mineral, and being, as it is, in close proximity to lead-bearing limestone, the carbonate of lead, which is lighter than galena, may have been carried by such currents to the site of the tin deposits; carried it must have been somehow or other, for there it is, but no river could have brought it.

Above Banisita, there are some stiff rapids and the river passes through mountain fastnesses presenting some of the wildest and most attractive scenery that the mind can conceive of; lofty moun-

tain walls rise perpendicularly from the water's edge and along the line of vision vistas of cliff, rock and foliage, all mingled in picturesque confusion afford a rich succession of dioramic views, and as evening approaches one may occasionally descry in the far distance some isolated limestone peak suddenly jutting island-like from amidst the sea of jungle, its saffron-tinted crest illuminated by the sunset and gleaming like a topaz from out the emerald setting of the surrounding forest.

Indeed it may be said of the limestone country of Patani that it is a scenic kaleidoscope of Nature's choicest construction.

WILLIAM CAMERON.

